UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CURRENT WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN NORTH DAKOTA-- Fiscal Year 1981

Compiled by Cathy R. Martin and Luverne L. Albright

U.S. GEOLOGICAL SURVEY
Open-File Report 81-923

Bismarck, North Dakota
July 1981

UNITED STATES DEPARTMENT OF THE INTERIOR
JAMES G. WATT, Secretary
GEOLOGICAL SURVEY
Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey
821 East Interstate Avenue
Bismarck, ND 58501

For sale by:

Open-File Services Section
Distribution Branch
U.S. Geological Survey, MS 306
Box 25425, Denver Federal Center
Denver, CO 80225

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CURRENT WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN NORTH DAKOTA--Fiscal Year 1981

INTRODUCTION

The U.S. Geological Survey, through its Water Resources Division, investigates the occurrence, quantity, quality, distribution, and movement of the surface and underground water that composes the Nation's water resources. This publication contains a brief description of the ongoing investigations of the North Dakota District.

Much of the Geological Survey program is conducted in cooperation with several state agencies and other Federal agencies. The publications resulting from the program are listed periodically in a miscellaneous release titled, "Water Resources Investigations in North Dakota, 19xx." The last such release was issued in 1976. They are also listed in a monthly nationwide release titled, "New Publications of the Geological Survey, List xxx--Publications issued in month 19xx."

DATA-COLLECTION PROJECTS

The U.S. Geological Survey continually records stage, discharge, quality of water, sediment concentration, and groundwater levels at selected sites throughout North Dakota. Some of the stations are operated on a long-term basis to sample trends in the gross water supply, while others are operated for short terms for correlation with long term to gain wider areal coverage or for specific purposes. The information is published annually in water-data reports and stored in computer files for retrieval and processing.

PROJECT TITLE: Surface-Water Stations

LOCATION: Statewide

PERIOD OF PROJECT: Continuous

PROJECT CHIEF: Russell E. Harkness

OBJECTIVES.--To collect surface-water data sufficient to satisfy needs for current purpose uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting, (4) disposal of wastes and pollution controls, (5) discharge data to accompany water-quality measurements, (6) compact and legal requirements, and (7) research or special studies. To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, etc., for use in planning and design.

APPROACH.--Standard methods of data collection will be used as described in the series, "Techniques of Water Resources Investigations of the United States Geological Survey." Partial-record gaging will be used instead of complete-record gaging where it serves the required purpose.

PROGRESS IN 1980.--All network (fig. 1) data were collected on schedule and annual water-year records are being prepared for publication.

PLANS FOR 1981.--Continue to operate network. As many as eight streamflow gages may be added following spring breakup. Two electromagnetic flow meters for direct determination of stream velocity will be added at existing stations. Three continuous-record stations will be discontinued.

REPORT PRODUCTS.--U.S. Geological Survey, Water-resources data for North Dakota, Water year 1980 (planned).

U.S. Geological Survey, 1980, Water-resources data for North Dakota, Water year 1979: U.S. Geological Survey Water-Data Report ND-79-1, 784 p.

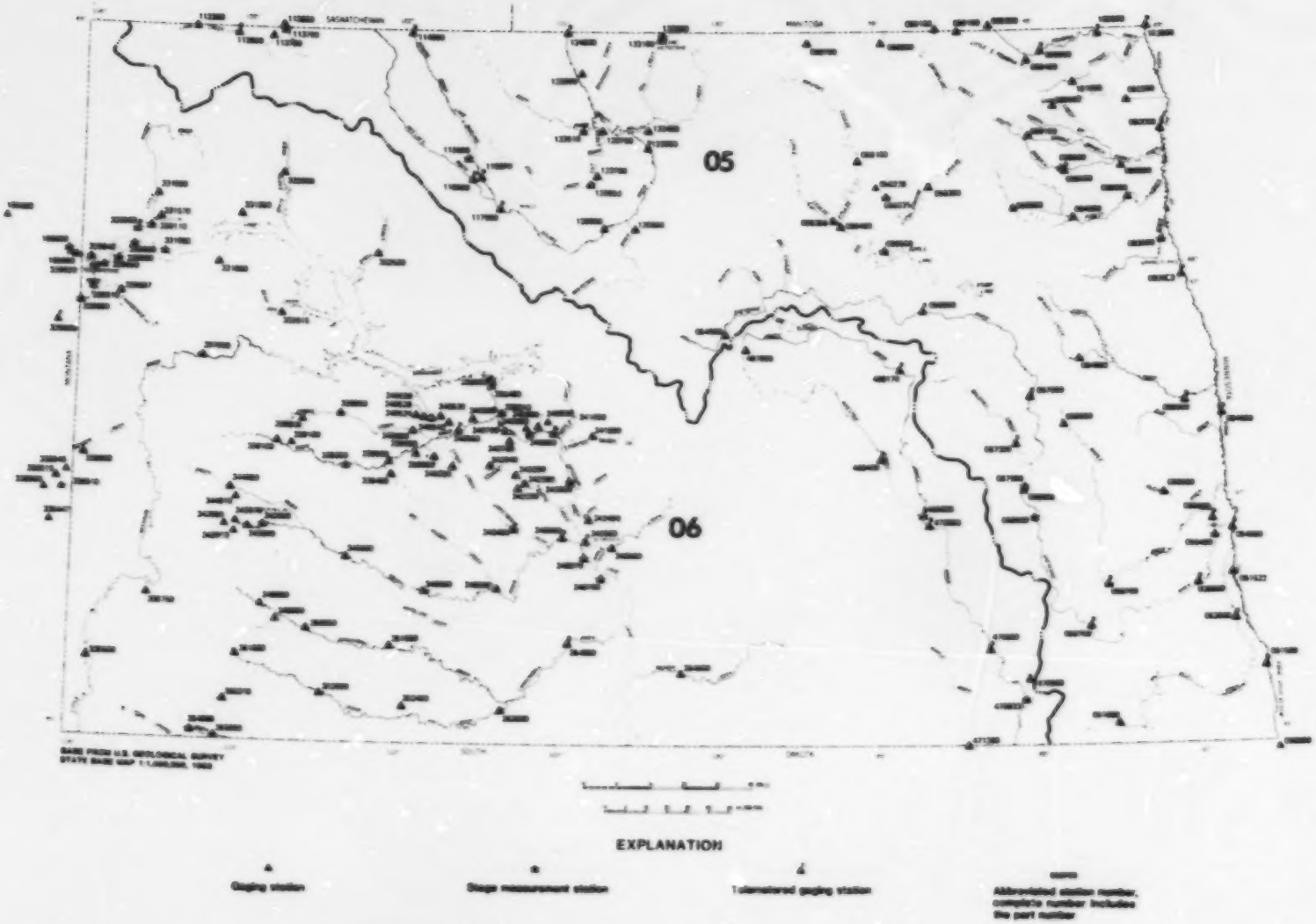
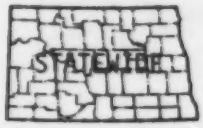


FIGURE 1--Locations of lake, crest-stage and stream gaging stations.

PROJECT TITLE: Water-Quality Stations

LOCATION: Statewide



PERIOD OF PROJECT: Continuous

PROJECT CHIEF: Robert L. Houghton

OBJECTIVES.--To provide a national bank of water-quality data for broad Federal planning and action programs and to provide data for Federal management of interstate and international waters.

APPROACH.--Operation of a network of water-quality stations to provide average chemical concentrations, loads, and time trends as required by planning and management agencies.

PROGRESS IN 1980.--All network (fig. 2) data were collected on schedule and records are being prepared for publication.

PLANS FOR 1981.--The network will continue to operate with a few cooperator-requested modifications. The quality water station at Bismarck will be relocated to Schmidt, although sediment will continue to be collected at Bismarck. Organic carbon, phytoplankton, and some trace elements will be dropped at the new Schmidt site. A collection network will be established at Lake Ashtabula to sample composite nutrients and bottom pesticides. Lake Carmel and Lake Renwick and their inflows and outflows are discontinued, and only two intensive study state lakes retained. Park River water-quality stations and Deep River at Upham are discontinued. Sites along the Pembina River are reduced and sediment dropped at the Walhalla site. NASQAN sites on the Heart River near Mandan and the Knife River at Hazen are reduced from monthly to bimonthly sampling sites.

REPORT PRODUCTS.--U.S. Geological Survey, Water-resources data for North Dakota, Water year 1980 (planned).

U.S. Geological Survey, 1980, Water-resources data for North Dakota, Water year 1979: U.S. Geological Survey Water-Data Report ND-79-1, 784 p.

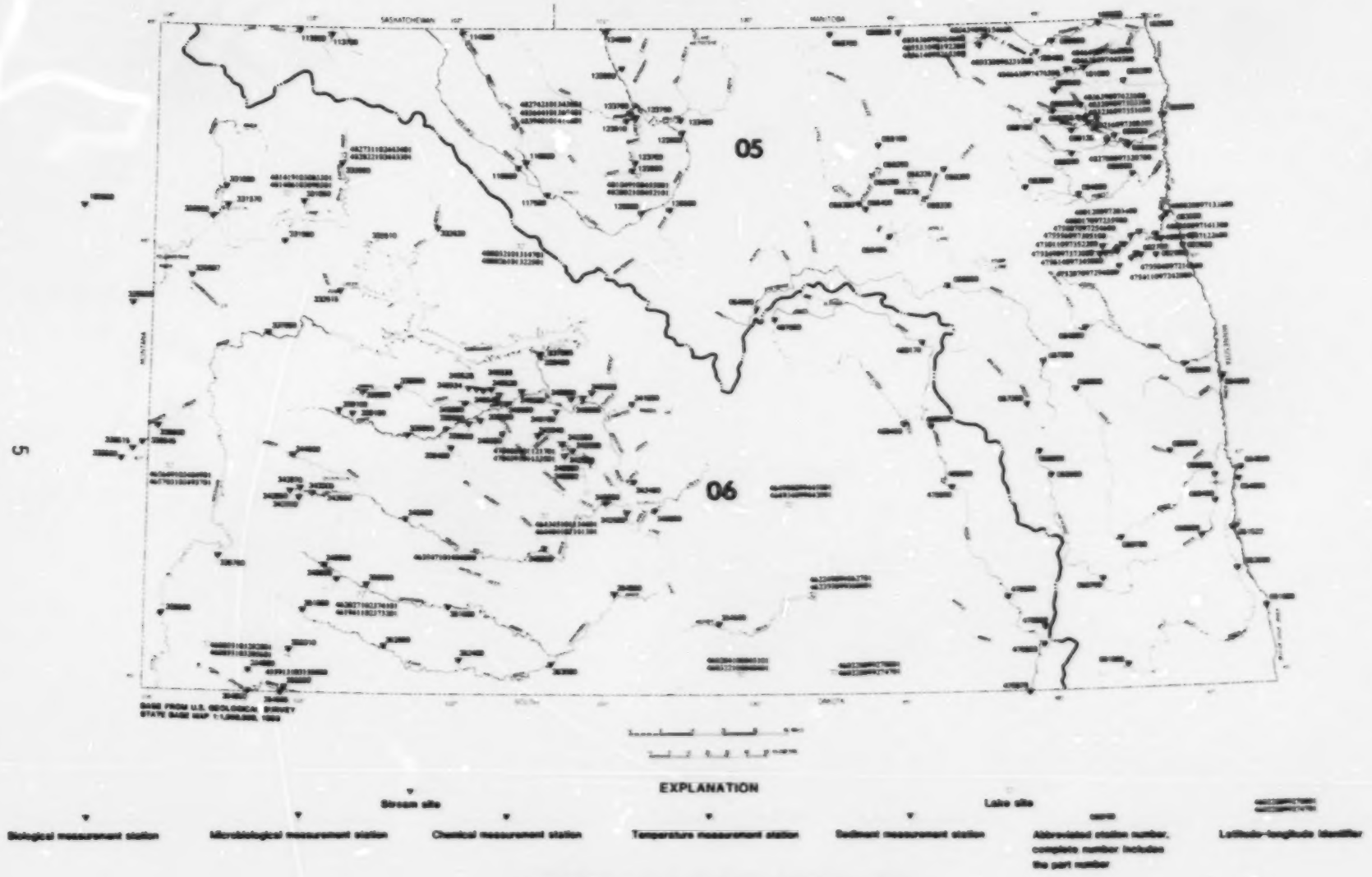


FIGURE 2–Locations of water-quality stations.

PROJECT TITLE: Sediment Stations

LOCATION: Statewide

PERIOD OF PROJECT: Continuous

PROJECT CHIEF: David B. Hanson

OBJECTIVES.--To provide a national bank of sediment data for use in broad Federal and state planning and action programs and to provide data for Federal management of interstate and international waters.

APPROACH.--Establish and operate a network of sediment stations to provide spatial and temporal averages and trends of sediment concentration, sediment discharge, and particle size of sediment being transported by rivers and streams.

PROGRESS IN 1980.--Data were collected and analyzed for three daily stations and 29 partial-record stations (fig. 2). Records are being prepared for publication. Bedload data was collected at one site using a Helley-Smith sampler.

PLANS FOR 1981.--Continue to operate network. Two daily sediment stations will be discontinued.

REPORT PRODUCTS.--U.S. Geological Survey, Water-resources data for North Dakota, Water year 1980 (planned).

U.S. Geological Survey, 1980, Water-resources data for North Dakota, Water year 1979: U.S. Geological Survey Water-Data Report ND-79-1, 784 p.

PROJECT TITLE: Ground-Water Stations

LOCATION: Statewide

PERIOD OF PROJECT: Continuous

PROJECT CHIEF: Russell E. Harkness

OBJECTIVES.--To collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. To provide a data base against which the short-term records acquired in areal studies can be analyzed. This analysis must (1) provide an assessment of the ground-water resources, (2) allow prediction of future conditions, (3) detect and define pollution and supply problems, and (4) provide the data base necessary for management of the resources.

APPROACH.--Evaluation of regional geology allows broad, general definition of aquifer systems and their boundary conditions. Within this framework and with some knowledge of the stress on the system in time and space and the hydrologic properties of the aquifers, a subjective decision can be made on the most advantageous locations of observation wells to determine long-term system behavior. This subjective network can be refined as records become available and detailed areal studies of the ground-water system more closely define the aquifers, their properties, and the stresses to which they are subjected.

PROGRESS IN 1980.--All network data were collected on schedule. All data were tabulated and stored in District and Watstore files. Previous years' water-level measurement data have been reviewed and updated in Watstore files. A review of historic daily record was started.

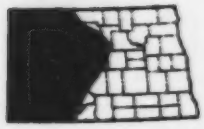
PLANS FOR 1981.--Two counties will be added to the network. Adjustments to current network will be made in consultation with cooperators. The review of historic daily record will be completed.

REPORT PRODUCTS.--U.S. Geological Survey, 1977, Ground-water levels in the United States, 1972-74, North Central States: U.S. Geological Survey Water-Supply Paper 2163.

Ground-water data for the basic network (fig. 3) will be published in, "U.S. Geological Survey, Water-Resources Data for North Dakota, Water Year 1980" (planned).

FIGURE 3--Locations of ground-water observation wells.

PROJECT TITLE: Water-Resources Monitoring West-Central Coal Region, North Dakota



LOCATION: West-Central North Dakota

PERIOD OF PROJECT: Continuous

PROJECT CHIEF: Norman D. Haffield

OBJECTIVES.--The objective of the program is to determine the characteristics of the regional water-resources system and to detect and document changes in the system or in its components that may be associated with coal mining should changes occur.

APPROACH.--Evaluate the existing water-resources monitoring program for its regional surveillance value and add additional data sites or upgrade existing sites as needed. Evaluate data that continuously or periodically describe ground-water levels and their quality and streamflows and their quality so that changes may be detected and documented.

PROGRESS IN 1980.--Monitoring of water resources in the areas of anticipated coal development is continuing. Ground-water levels were measured and samples were obtained at 52 sites in the potential coal-producing areas.

PLANS FOR 1981.--The network of contractor-operated surface-water and water-quality stations will continue to provide monitoring of the regional system. The ground-water wells will be measured and sampled on an annual basis. A report summarizing and evaluating the data collected at the sites is being prepared.

REPORT PRODUCTS.--Streamflow and water quality for streams in Fort Union coal region in North Dakota (in progress).

PROJECT TITLE: North Dakota Water-Use Data Acquisition and Dissemination Program

LOCATION: Statewide

PERIOD OF PROJECT: Continuous

PROJECT CHIEF: Michael Smith, North Dakota State Water Commission

OBJECTIVES.--This study will establish a program to provide water-use information for the optimum utilization and management of the State's water resources. The program will collect, store, and disseminate water-use data to complement data on availability and quality of the State's water resources.

APPROACH.--Withdrawal uses can be evaluated quantitatively because they require removal of the water from the ground, stream, lake, or reservoir. The categories that would be applicable for obtaining the total withdrawals are irrigation, municipal use, industrial self-supply, agricultural (nonirrigation), dewatering, and injection. The total quantity of the water withdrawn can be obtained by adding together the known amounts of withdrawals. Two nonwithdrawal uses that need to be considered are recreation and preservation. For each of these categories, not only the record of withdrawal would be collected but other pertinent information that would be useful in water-use analysis.

PROGRESS IN 1980.--During the past year, 25 inductive time totalizers were installed on irrigation wells in an experimental program to improve data accuracy. A Clampitron flow meter was also acquired and pumping rates measured on about 100 irrigation wells. Preliminary results indicate that inline flow meters required by the State were generally within 10 percent if working; however, only about one-half were found operational. It was also found that total pumpage estimated by the user through other means was usually too high--actual pumpage is less than user estimate. The State Water Commission has moved their permitting data base to a recently acquired Harris computer. This will eventually provide more flexibility in meeting National program objectives. Industrial water-use data for 1978 was aggregated and stored on all four data bases.

PLANS FOR 1981.--(1) Aggregate and store 1980 water-use data in NWUDB (National Water Use Data Base). (2) Prepare initial water-use report on 1980 data using NWUDB. (3) Add elements required by NWUDB to permitting system on State's Harris computer. Develop programs for aggregation of data using ADP methods if within funding limitations. (4) Extend use of totalizers to 150-160 statewide to obtain a representative sample of monthly use data. A mail-in program and(or) field collection of E-cells will be set up. (5) Continued use of the Clampitron flow meter will be extensive. (6) Feasibility of further subdivision of municipal withdrawals by use category will be investigated. (7) Experimental use of the newly developed Doppler type meter employing the E-cell will be investigated. (8) The North Dakota District will be the receiving center for E-cells for the Central Region. A multiple reader provided by the National Program Office will be put into use.

REPORT PRODUCTS.--U.S. Geological Survey, Water-use data for North Dakota (planned).

COUNTY GROUND-WATER STUDIES

The Geological Survey has for several years had a continuing program in cooperation with state and other Federal agencies to investigate the ground-water resources of the counties in North Dakota. The studies are conducted under county or multicounty boundaries and every county has a study completed or in progress (fig. 4).

PROJECT TITLE: Ground-Water Resources of Logan County, North Dakota

LOCATION: South-Central North Dakota

PERIOD OF PROJECT: October 1977 to September 1980

PROJECT CHIEF: Robert L. Klausing

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantity of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; (5) to determine the chemical quality of the water; and (6) to identify current and projected use of ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) test drilling, (4) chemical quality of water sampling and analysis, (5) aquifer tests and special studies, (6) data compilation and analysis, and (7) report preparation.

PROGRESS IN 1980.--Test drilling and collection of water samples and geohydrologic data have been completed. All data have been entered into the computer filing system. The first drafts of the reports, "Ground-Water Data for Logan County, North Dakota," and "Ground-Water Resources of Logan County, North Dakota," have been completed and are waiting to be typed and reviewed.

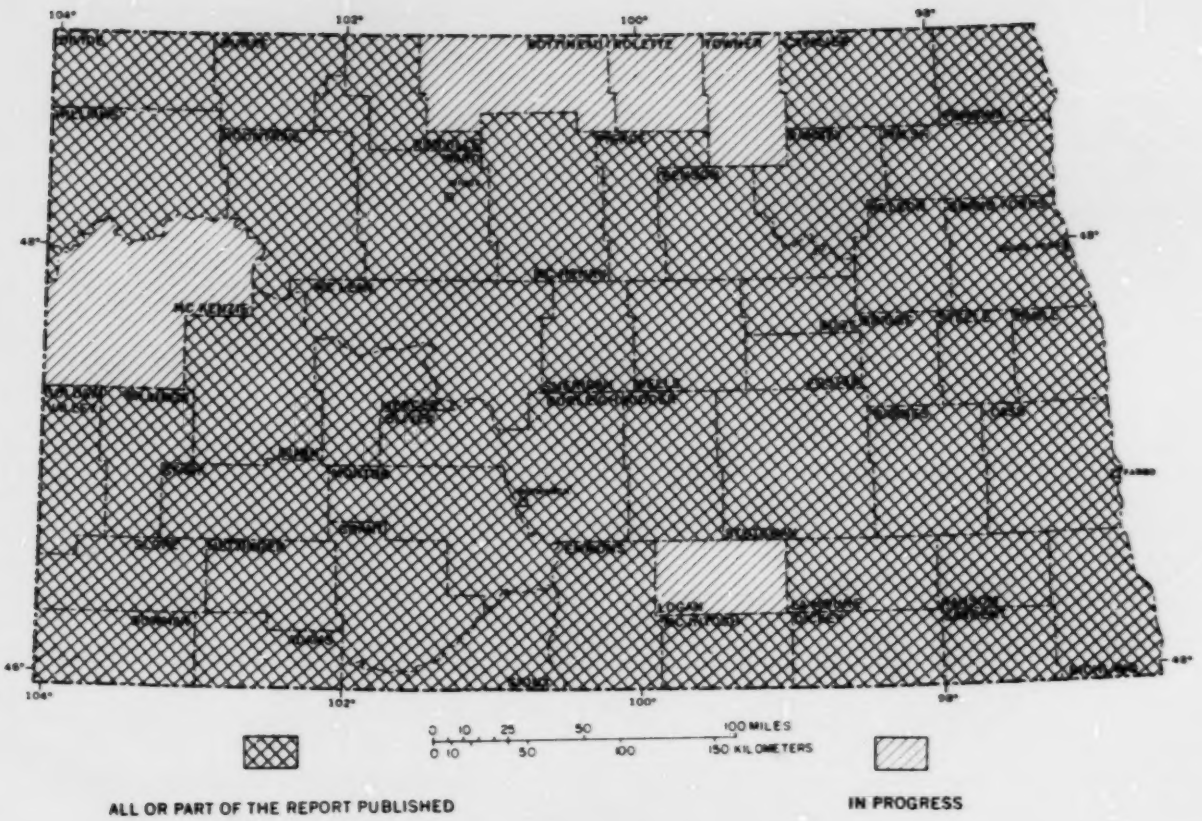


FIGURE 4.—Locations of county ground-water studies.

PLANS FOR 1981.--Revise reports, if necessary, according to reviewer's comments. Obtain Director's approval for publication.

REPORT PRODUCTS.--Ground-water data for Logan County, North Dakota (in progress).

Ground-water resources of Logan County, North Dakota (in progress).

PROJECT TITLE: Ground-Water Resources of Ransom and Sargent Counties, North Dakota

LOCATION: Southeastern North Dakota

PERIOD OF PROJECT: July 1974 to June 1978

PROJECT CHIEF: Clarence A. Armstrong

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantities of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; and (5) to determine the chemical quality of the ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) geologic mapping, (4) test drilling, (5) chemical quality of water sampling and analyses, (6) aquifer tests and special studies, (7) data compilation and analysis, and (8) report preparation.

PROGRESS IN 1980.--The preliminary water availability map was approved. The final interpretive report is being prepared.

PLANS FOR 1981.--Obtain Director's approval for publication.

REPORT PRODUCTS.--Geology and ground-water resources of Ransom and Sargent Counties, North Dakota, pt. I, Geology (planned).

Ground-water resources of Ransom and Sargent Counties, North Dakota (planned).

Armstrong, C. A., 1979, Ground-water data for Ransom and Sargent Counties, North Dakota: North Dakota State Water Commission County Ground-Water Studies 31, pt. II, and North Dakota Geological Survey Bulletin 69, pt. II, 637 p.

PROJECT TITLE: Ground-Water Resources of McHenry and Sheridan Counties, North Dakota

LOCATION: North-Central North Dakota

PERIOD OF PROJECT: July 1975 to June 1979

PROJECT CHIEF: Philip G. Randich

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantities of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; and (5) to determine the chemical quality of the ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) geologic mapping, (4) test drilling, (5) chemical quality of water sampling and analyses, (6) aquifer tests and special studies, (7) data compilation and analysis, and (8) report preparation.

PROGRESS IN 1980.--Preliminary maps showing availability of ground water from glacial-drift aquifers were prepared for Sheridan and McHenry Counties. The ground-water data reports for both counties were approved for publication. The final interpretive report on the ground-water resources of Sheridan County was approved. The final interpretive report on the ground-water resources of McHenry County is in in-house review.

PLANS FOR 1981.--Complete the review of the final report on McHenry County and obtain Director's approval for publication.

REPORT PRODUCTS.--Geology and ground-water resources of McHenry and Sheridan Counties, North Dakota, pt. I, Geology (planned).

Ground-water resources of McHenry County, North Dakota (in progress).

Randich, P. G., 1980, Ground-water data for McHenry County, North Dakota: North Dakota State Water Commission County Ground-Water Studies 33, pt. II, and North Dakota Geological Survey Bulletin 74, pt. II, 446 p.

Burkart, M. R., 1980, Ground-water data for Sheridan County, North Dakota: North Dakota State Water Commission County Ground-Water Studies 32, pt. II, and North Dakota Geological Survey Bulletin 75, pt. II, 302 p.

Burkart, M. R., 1980, Ground-water resources of Sheridan County, North Dakota: North Dakota State Water Commission County Ground-Water Studies 32, pt. III, and North Dakota Geological Survey Bulletin 75, pt. III, 32 p.

Burkart, M. R., and Randich, P. G., 1980, Preliminary map showing availability of ground water from glacial-drift aquifers in Sheridan County, central North Dakota: U.S. Geological Survey Open-File Report 80-504W, 1 p.

Randich, P. G., 1980, Preliminary map showing availability of ground water from glacial-drift aquifers in McHenry County, north-central North Dakota: U.S. Geological Survey Open-File Report 80-562, 1 p.

PROJECT TITLE: Ground-Water Resources of McIntosh County, North Dakota

LOCATION: South-Central North Dakota

PERIOD OF PROJECT: July 1975 to June 1978

PROJECT CHIEF: Robert L. Klausing

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantity of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; and (5) to determine the chemical quality of the ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) test drilling, (4) chemical quality of water sampling and analyses, (5) aquifer tests and special studies, (6) data compilation and analysis, and (7) report preparation.

PROGRESS IN 1980.--Final interpretive report was completed and has been approved through Region.

PLANS FOR 1981.--Obtain Director's approval for publication.

REPORT PRODUCTS.--Ground-water resources of McIntosh County, North Dakota (in progress).

Klausing, R. L., 1979, Ground-water basic data for McIntosh County, North Dakota: North Dakota State Water Commission County Ground-Water Studies 30, pt. II, and North Dakota Geological Survey Bulletin 73, pt. II, 458 p.

PROJECT TITLE: Ground-Water Resources of Bottineau and Rolette Counties, North Dakota

LOCATION: North-Central North Dakota

PERIOD OF PROJECT: October 1977 to October 1981

PROJECT CHIEF: Philip G. Randich

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantities of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; (5) to determine the chemical quality of the ground water; and (6) to identify current and potential use of ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) geologic mapping, (4) test drilling, (5) chemical quality of water sampling and analyses, (6) aquifer tests and special studies, (7) data compilation and analysis, and (8) report preparation.

PROGRESS IN 1980.--All scheduled fieldwork except the last phase of test drilling and associated work has been completed. The basic-data report is about 20 percent completed. The Shell Valley aquifer, which furnishes water for the city of Belcourt, has been traced to the vicinity of the city of Rolette where the aquifer deposits are both finer grained and generally thinner.

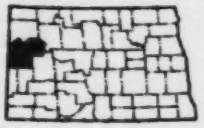
PLANS FOR 1981.--Plans are to finish test drilling and to develop and sample any observation wells which may be installed. Because of the late scheduling of test drilling, monthly water-level measurements will continue into December. The basic-data and interpretive reports will be completed and submitted for review.

REPORT PRODUCTS.--Geology and ground-water resources of Bottineau and Rolette Counties, North Dakota, pt. I, Geology (planned).

Geology and ground-water resources of Bottineau and Rolette Counties, North Dakota, pt. II, Basic data (planned).

Geology and ground-water resources of Bottineau and Rolette Counties, North Dakota, pt. III, Ground-water resources (planned).

PROJECT TITLE: Ground-Water Resources of McKenzie County, North Dakota



LOCATION: Western North Dakota

PERIOD OF PROJECT: October 1978 to September 1982

PROJECT CHIEF: Mack G. Croft

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers and confining beds; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantities of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; and (5) to determine the chemical quality of the ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) geologic mapping, (4) test drilling, (5) chemical quality of water sampling and analyses, (6) aquifer tests and special studies, (7) data compilation and analysis, and (8) report preparation.

PROGRESS IN 1980.--Three test holes ranging from 1,800 to 2,100 feet deep have been drilled to the Pierre Shale. Glacial channels, some containing gravel, have been outlined in the northern part of the county and about 75 test wells have been drilled into them. The well canvas is about 50 percent complete. About 150 water samples have been collected and submitted for analysis.

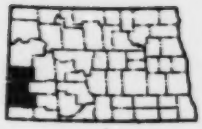
PLANS FOR 1981.--Plans for next year include drilling one more deep test well to the Pierre Shale and about 25 more test wells to better define the glacial channels. The well inventory will be completed. A preliminary analysis will be made of the available data.

REPORT PRODUCTS.--Geology and ground-water resources of McKenzie County, North Dakota, pt. I, Geology (planned).

Geology and ground-water resources of McKenzie County, North Dakota, pt. II, Basic data (planned).

Geology and ground-water resources of McKenzie County, North Dakota, pt. III, Ground-water resources (planned).

PROJECT TITLE: Ground-Water Resources of Billings, Golden Valley, and Slope Counties, North Dakota



LOCATION: Southwestern North Dakota

PERIOD OF PROJECT: July 1974 to June 1978

PROJECT CHIEF: Lawrence O. Anna

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantities of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; and (5) to determine the chemical quality of the ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) geologic mapping, (4) test drilling, (5) chemical quality of water sampling and analyses, (6) aquifer tests and special studies, (7) data compilation and analysis, and (8) report preparation.

PROGRESS IN 1980.--Final report finished and received Director's approval for publication.

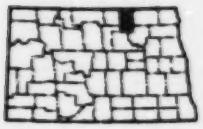
PLANS FOR 1981.--Publish final report.

REPORT PRODUCTS.--Geology and ground-water resources of Billings, Golden Valley, and Slope Counties, North Dakota, pt. I, Geology (planned).

Anna, L. O., 1980, Ground-water data of Billings, Golden Valley, and Slope Counties, North Dakota: North Dakota State Water Commission County Ground-Water Studies 29, pt. II, and North Dakota Geological Survey Bulletin 76, pt. II, 241 p.

Anna, L. O., 1980, Ground-water resources of Billings, Golden Valley, and Slope Counties, North Dakota: North Dakota State Water Commission County Ground-Water Studies 29, pt. III, and North Dakota Geological Survey Bulletin 76, pt. III, 56 p.

PROJECT TITLE: Ground-Water Resources of Towner County, North Dakota



LOCATION: North-Central North Dakota

PERIOD OF PROJECT: October 1979 to September 1982

PROJECT CHIEF: Philip G. Randich

OBJECTIVES.--The purpose of the investigation is to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives are (1) to determine the location, extent, and nature of the major aquifers; (2) to evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) to estimate the quantities of water stored in the aquifers; (4) to estimate the potential yields to wells tapping the major aquifers; (5) to determine the chemical quality of the ground water; and (6) to identify current and potential use of ground water.

APPROACH.--This is a relatively comprehensive study of the ground-water resources. The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) geologic mapping, (4) test drilling, (5) chemical quality of water sampling and analyses, (6) aquifer tests and special studies, (7) data compilation and analysis, and (8) report preparation.

PROGRESS IN 1980.--Phase 1 of the drilling, collection of water samples, and well inventory has been completed. An extension of the Spiritwood aquifer system was traced from Ramsey County through Towner County, toward Canada. The system contains greater than 100 feet of saturated sand and gravel in places and is the major aquifer in the area.

PLANS FOR 1981.--Plans for next year include phase 2 which will be completion of all fieldwork for the project. Preliminary maps and compilation of data for report preparation will be started.

REPORT PRODUCTS.--Geology and ground-water resources of Towner County, North Dakota, pt. I, Geology (planned).

Geology and ground-water resources of Towner County, North Dakota, pt. II, Basic data (planned).

Geology and ground-water resouces of Towner County, North Dakota, pt. III, Ground-water resources (planned).

Open-file map showing potential yield and location of major aquifers in the glacial drift (planned).

REGIONAL STUDIES

In anticipation of water demands on a scale unlimited by political boundaries or local problems, the Geological Survey is conducting studies of regional ground-water systems. Some of these studies are in cooperation with other agencies. The studies are directed toward definition of the systems and prediction of the effects of stresses that could be imposed by present and future management plans.

PROJECT TITLE: Availability of Ground Water from Aquifers in the Cretaceous and Tertiary Systems in the Fort Union Coal Region

LOCATION: Northern Great Plains (SD ND MT WY)

PERIOD OF PROJECT: July 1974 to June 1977

PROJECT CHIEF: Mack G. Croft

OBJECTIVES.--The major objectives are (1) to determine the location, extent, and nature of the major aquifers and confining beds in the Cretaceous and Tertiary systems in the Fort Union coal region; (2) to evaluate the occurrence, movement, and availability of ground water, including sources of recharge and discharge; and (3) to determine the chemical quality of the ground water.

APPROACH.--The investigation will be concerned mainly with the compilation, analysis, and interpretation of existing pertinent data from available sources in the States of North Dakota, South Dakota, Wyoming, and Montana. Major aquifers in the Cretaceous and Tertiary systems will be identified, described, and correlated mainly through the use of geophysical and lithologic logs. Three regional hydrogeologic sections will be prepared that will illustrate the structural and stratigraphic relationships of the major aquifers. A structural map will be prepared, using the top of the Pierre Formation which, for much of the region, also will represent the lower limit of potable ground water. The final report will be prepared in the professional paper or water-resources investigations series.

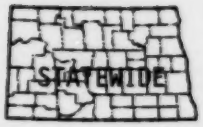
PROGRESS IN 1980.--The final interpretive report was revised following extensive in-house review.

PLANS FOR 1981.--Plans for 1981 include final data check and editorial review followed by reviews leading to Director's approval for publication.

REPORT PRODUCTS.--Croft, M. G., and others, Geology and ground-water resources of Late Cretaceous and Tertiary rocks, Fort Union coal region (in progress).

Thorstenson, D. C., Fisher, D. W., and Croft, M. G., 1979, The geochemistry of the Fox Hills-basal Hell Creek aquifer in southwestern North Dakota and northwestern South Dakota: Water Resources Research v. 15, no. 6, p. 1,479-1,498.

PROJECT TITLE: Northern Great Plains Regional Aquifer Assessment in North Dakota



LOCATION: Statewide

PERIOD OF PROJECT: October 1977 to September 1981

PROJECT CHIEF: Ray D. Butler

OBJECTIVES.--The purpose of this study is to assess the availability and quality of water in the rocks overlying the Madison Group (to show relationship to previous study) in the northern Great Plains. The specific objectives are to determine (1) aquifer boundaries, depths, and thicknesses; (2) hydrologic properties of the aquifers; (3) storage capacity of the aquifers; (4) estimated sustained yields of the aquifers; (5) quality of the water and the source of any pollutants found therein; (6) sources of recharge and discharge; and (7) effects of withdrawals, both on the aquifer systems and on surface-water supplies in areas where there are hydraulic connections.

APPROACH.--An intensive search will be made of available literature and other sources for pertinent data on the formations to be studied. A compilation of these data should indicate where further information is needed. Test drilling will be contracted with geophysical logging, aquifer testing, water-quality analysis, and hydrologic parameter testing. The aquifer system will be simulated with a multilayer digital model to evaluate future stresses on the system.

PROGRESS IN 1980.--Detailed geologic and hydrologic maps were completed to describe the aquifers over the State. Preliminary digital models of the Fox Hills-lower Hell Creek aquifer and the Dakota aquifer were expanded.

PLANS FOR 1981.--Preliminary digital models of the Fox Hills-lower Hell Creek aquifer and the Dakota aquifer will be completed. Additional data on water use are to be gathered for establishing a monitoring system of Cretaceous and Tertiary aquifers.

REPORT PRODUCTS.--Northern Great Plains regional aquifer assessment (planned).

Preliminary digital model of Fox Hills-lower Hell Creek aquifer (planned).

Preliminary digital model of the Dakota aquifer (planned).

Geochemistry of Cretaceous and Tertiary rocks: (1) Basic data (planned).

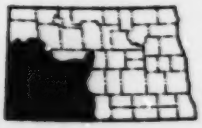
Geochemistry of Cretaceous and Tertiary rocks: (2) Geochemistry (planned).

Structure contour maps of Jurassic, Cretaceous, and Tertiary rocks in North Dakota (in progress).

Sandstone thickness maps of Jurassic, Cretaceous, and Tertiary rocks in North Dakota (in progress).

Geologic cross sections of Jurassic, Cretaceous, and Tertiary rocks in North Dakota (in progress).

PROJECT TITLE: Hydrology of Area 47, Northern Great Plains Coal Province, North Dakota



LOCATION: Southwestern North Dakota

PERIOD OF PROJECT: March 1981 to September 1982

PROJECT CHIEF: Anne H. Harrington

OBJECTIVES.--The purpose is to describe the hydrology of Area 47 in a format readily usable by the coal-mining industry, the regulatory agencies, interest groups (such as environmental organizations), and the general public. The specific objectives of the study are to present (1) a description of the area in a hydrologic framework, (2) a quantitative assessment of the occurrence and availability of water, (3) an assessment of the present quality of available water, and (4) an identification of current and planned utilization of water.

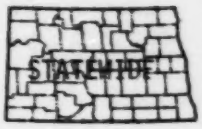
APPROACH.--A topic outline will be developed, based on the Alabama Area report. Only existing data will be utilized to establish an information framework for the study area. All available information obtained from a literature review and all available data will be used to prepare graphs, maps, and text to fulfill the objectives of the study. The report will be prepared in accordance with the STOP (Sequential Thematic Organization of Publications) format.

PROGRESS IN 1980.--None. New project.

PLANS FOR 1981.--The final topic outline for the report and a work schedule for completion of all sections of the report will be prepared. All available information will be assembled, summarized, and interpreted for presentation. Approximately one-fourth of the sections will be completed. Base maps will be obtained through the Wisconsin District.

REPORT PRODUCTS.--Hydrology of Area 47, northern Great Plains coal province, North Dakota (planned).

PROJECT TITLE: Public-Orientated Report on Ground Water in North Dakota in the STOP Format



LOCATION: Statewide

PERIOD OF PROJECT: March 1981 to June 1982

PROJECT CHIEF: Quentin F. Paulson

OBJECTIVES.--The project has two main objectives: (1) To prepare a brief summary report on ground-water resources of North Dakota, and (2) to prepare the report in a format that will be readily usable by the general public and also may have transfer value to other projects.

APPROACH.--The approach will be to compile and review existing sources of ground-water information. No new data will be collected. Prepare an outline of the project report. Base maps showing locations of aquifers will be prepared using scale-stable materials. Diagrams, graphs, cross sections, and photographs illustrating ground-water concepts will be designed. Report will be prepared in the STOP (Sequential Thematic Organization of Publications) format.

PROGRESS IN 1980.--None. New project.

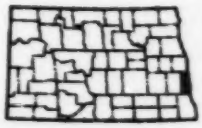
PLANS FOR 1981.--Text preparation, report mockup, mockup review, final report preparation, final review, and publication.

REPORT PRODUCTS.--Public-orientated report on ground water in North Dakota in the STOP format [may be published as a Special Report (SP) rather than a Water-Supply Paper] (planned).

AQUIFER EVALUATIONS

As the county ground-water resources studies have been completed, there has generally been renewed interest in irrigation where suitable water was found available. The stress placed on some of the somewhat limited drift aquifers has led to a program aimed at evaluating the aquifers for development of the ground-water supply and to enhance the assessment of the State's water resources.

PROJECT TITLE: Evaluation of Hydrologic Effects of Withdrawal on the West Fargo Aquifer



LOCATION: Eastern Cass County, North Dakota

PERIOD OF PROJECT: October 1979 to September 1981

PROJECT CHIEF: Clarence A. Armstrong

OBJECTIVES.--(1) To describe the geometric and geologic characteristics of the aquifer. (2) To define the spatial distribution of the water-bearing properties of the aquifer, the head relationships, and the sources and amounts of recharge and discharge.

APPROACH.--There will be a careful review of published data and interpretations and data available from recent test drilling followed by a program of drilling of selected new test holes. A digital model of the aquifer will be developed as an aid in determining boundary conditions and data gaps and as a verification of the conceptual model.

PROGRESS IN 1980.--Geohydrologic data have been collected and a digital model has been constructed. However, there are a few inconsistencies, so calibration has not been completed.

PLANS FOR 1981.--Test drilling to further delineate the aquifer has been planned for early spring 1981. After the drilling, the model will be calibrated and a report describing the parameters and boundaries will be written. The report will also include the results of simulations using present and possible future pumping scenarios.

REPORT PRODUCTS.--Evaluation of hydrologic effects of withdrawal on the West Fargo aquifer (planned).

SPECIAL INVESTIGATIONS

Special hydrologic investigations are often needed to supplement the ongoing program. These special investigations include water-supply problems, drainage problems, ground-water and surface-water relationships, ground-water recharge, and water management. The objective is to assist state and other Federal agencies in solving water-resources problems on short notice.

PROJECT TITLE: Special Investigations

LOCATION: Statewide

PERIOD OF PROJECT: Continuous

PROJECT CHIEF: Clarence A. Armstrong

OBJECTIVES.--To provide adequate hydrologic data needed for the optimum development of the State's water resources, especially as related to problems of municipal, irrigation, and industrial water supplies.

APPROACH.--The methods of study are categorized by the following activities: (1) Project planning, (2) water records, (3) geologic mapping, (4) test drilling, (5) chemical quality of water sampling, (6) aquifer tests and special studies, (7) data compilation and analysis, and (8) report preparation.

PROGRESS IN 1980.--The report on the effects of the proposed Kindred Dam was completed in draft form and submitted to the Corps of Engineers and U.S. Geological Survey personnel for colleague review. Problems developed on the evapotranspiration function. The Englevale model project has been completed except for the final report.

PLANS FOR 1981.--Revise the Kindred model to incorporate a nonlinear evapotranspiration function. Complete the report and obtain Director's approval for publication. Complete the Englevale report and obtain Director's approval for publication.

REPORT PRODUCTS.--Predictive modeling of effects on the planned Kindred Lake on ground-water levels (supplement) (in progress).

Predictive modeling of pumping effects on the Englevale aquifer, Ransom County, North Dakota (in progress).

Burkart, M. R., 1979, An appraisal of pumping effects on the Edgeley aquifer, LaMoure County, North Dakota, as determined by a digital model: U.S. Geological Survey Open-File Report 79-748, 22 p.

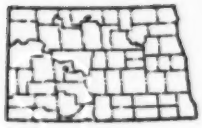
Croft, M. G., 1974, Water supply at Painted Canyon Overlook, Theodore Roosevelt National Memorial Park (South Unit), southwestern North Dakota: U.S. Geological Survey open-file report, 28 p.

Randich, P. G., 1975, Ground-water availability in the Belcourt area, Rolette County, North Dakota: U.S. Geological Survey open-file report, 35 p.

Sunderland, G. L., and Downey, J. S., 1975, Ground-water investigation for U.S. Air Force Launch Control Facility O-O, Griggs County, North Dakota: U.S. Geological Survey Open-File Report 75-345, 13 p.

Randich, P. G., 1977, Ground-water investigation at U.S. Air Force Launch Control Facility E-O, Ramsey County, North Dakota: U.S. Geological Survey Open-File Report 77-619, 23 p.

PROJECT TITLE: Sampling Landscape-Stratified Snow Covers by Ground and Airborne Snow Survey Techniques



LOCATION: Central North Dakota

PERIOD OF PROJECT: October 1980 to September 1982

PROJECT CHIEF: Douglas G. Emerson

OBJECTIVES.--The objectives of the study are (1) to investigate the possibilities of combining airborne snow survey and landscape-stratified sampling techniques to determine snow-water equivalents at selected landscape units; (2) to compare snow-cover densities for selected land-use types (stubble, fallow, brush, etc.) as determined by airborne and ground snow surveys, with the anticipation that snow-cover density could be monitored remotely from aircraft, leaving snow-depth measurements for rapid ground-based collection or vice versa; and (3) to evaluate the error associated in passing a gamma radiation scintillation counter (NAl) rapidly over snow covers differing in depth, water equivalent, and slope position such as evidenced on steep slopes of prairie ravines and large coulees.

APPROACH.--Two methods of making snow surveys will be used to obtain the objectives of the study. The first method is a ground snow survey using a terrain type land-use method as outlined by Steppuhn and Dyck[1/]. Pastures, cultivated fields, sloughs, brush, etc., within the same climatic region tend to accumulate snow according to recurring patterns unique to specific terrain type and land use. Therefore, snow samples are collected within similar areal units resulting in a ready, but statistically valid, method of estimating true snow-water equivalents. The second method is an airborne snow survey system based on the attenuation of natural terrestrial gamma radiation due to snow cover. The operational program serves primarily National Weather Service River Forecast Centers in the upper Midwest. The merits of a calibration flight line to accurately index the actual mean areal snow cover over the entire watershed will be examined.

1/Steppuhn, Harold, and Dyck, G. E., 1974, Estimating true basin snowcover; Proceedings of Symposium on Advanced Concepts and Techniques in the Study of Snow and Ice Resources: U.S. National Academy of Sciences, Washington, D.C., p. 314-324.

PROGRESS IN 1980.--None. New project.

PLANS FOR 1981.--To complete project planning. Initiate ground snow surveys and aerial snow surveys, computerize and analyze data. Prepare progress report.

REPORT PRODUCTS.--Aerial snow surveys in North Dakota (planned).

PROJECT TITLE: Pumping Technique Bias in Chemistry of Ground-Water Samples

LOCATION: Statewide

PERIOD OF PROJECT: October 1980 to September 1982

PROJECT CHIEF: Robert L. Houghton

OBJECTIVES.--The objective of this investigation is to determine the nature and magnitude of chemical biases introduced during the sampling of ground water by several different common pumping methods. Pumps being investigated include airlift, air squeeze, gas-driven reciprocating, peristaltic, and submersible. Comparison of analyses of ground water sampled by these techniques should provide a basis for evaluating historical ground-water data and determining preferred methods for future sampling.

APPROACH.--In phase 1 of the project, only wells cased with polyvinyl-chloride (PVC) liners and packed with nonreactive silica will be studied, thus minimizing water alteration due to well conditions. Metal casings can contribute significant trace metal loads to the samples, while PVC liners may enhance determined organic carbon values. During phase 2, wells of all types will be studied; but only water from wells of similar construction and composition will be considered in each statistical group. To fully assess the affected parameters, deep, intermediate, and shallow wells will be included. Further, to assure applicability of the results to all water types, wells yielding sulfate, bicarbonate, and chloride water will be studied.

PROGRESS IN 1980.--None. New project.

PLANS FOR 1981.--All sampling, data compilation, comparisons, and initial report preparation to be completed in FY81. Final report to be completed by December 1981.

REPORT PRODUCTS.--Biases in the chemical composition of ground water due to sampling techniques (planned).

PROJECT TITLE: Changes in Hydrologic Response of the Red River of the North Basin, North Dakota-Minnesota

LOCATION: Eastern North Dakota, Western Minnesota, and Northeastern South Dakota

PERIOD OF PROJECT: October 1980 to September 1981

PROJECT CHIEF: Jeffrey E. Miller

OBJECTIVES.--The objectives of this study are (1) to provide the background information on the changes in the Red River basin; (2) to document the changes in hydrologic characteristics with respect to flood peaks; and (3) based on the results of objectives 1 and 2, to make recommendations for further study.

APPROACH.--An analysis of currently available information will be done to determine if any significant changes in flooding have occurred. This will include a literature review to obtain background information on changes in land use and to examine previous work on the problem. A determination of possible flood frequency and climatic changes will be done using a number of analyses including data reviews, flood frequency, regression, normalized hydrographs, double-mass, and possible additional analyses. Also, an attempt will be made to quantify any response change identified.

PROGRESS IN 1980.--None. New project.

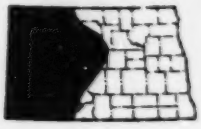
PLANS FOR 1981.--Literature review, hydrologic data development and analysis, and preparation of final report.

REPORT PRODUCTS.--Changes in hyrologic response of the Red River of the North basin (planned).

ENERGY-RELATED STUDIES

The expanding domestic energy demand has resulted in increased coal production and associated development in North Dakota. To meet the requirements for coal leasing and environmental protection, the Geological Survey has developed a program to evaluate the water resources in areas of current and planned development. This program is effected through the cooperation of interested agencies and Geological Survey funds.

PROJECT TITLE: Hydrologic Changes Due to Lignite Mining in North Dakota, Part 1-Reconnaissance of Strippable Lignite Deposits



LOCATION: Western North Dakota

PERIOD OF PROJECT: July 1974 to June 1977

PROJECT CHIEF: William F. Horak, Jr.

OBJECTIVES.--The project objectives are to define for each strippable lignite deposit (as identified in publications of the U.S. Bureau of Mines and the U.S. Geological Survey) the following information: (1) A summary of local geologic conditions; (2) description of the local ground-water flow system; (3) flow characteristics of the streams; (4) chemical quality of water from streams, lakes, and aquifers; (5) stream sediment loads; and (6) recommendations for more intensive hydrologic studies in probable problem areas.

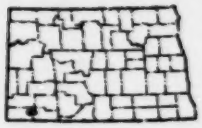
APPROACH.--A field reconnaissance will be made to evaluate the deposit areas in regard to geology, topography, and land use. A literature and data search will be made and all hydrologic and geologic data computerized. Conceptual models will be developed for each site through preliminary analysis and interpretation of available data. Additional data needs will be defined and a program of data collection instituted. These data will then be used to further develop and test the conceptual models. The probable hydrologic changes due to mining will be evaluated for each deposit, and recommendations for areas of future intensive hydrologic study will be made.

PROGRESS IN 1980.--The final report was completed and submitted for in-house review.

PLANS FOR 1981.--The review process will be completed and the report submitted to the Director for approval for publication.

REPORT PRODUCTS.--Horak, W. F., Jr., Hydrologic reconnaissance of lignite deposit areas in North Dakota (in progress).

PROJECT TITLE: Hydrologic Effects of Strip Mining in the Gascoyne Area, Bowman County, North Dakota



LOCATION: Southwestern North Dakota

PERIOD OF PROJECT: July 1975 to June 1978

PROJECT CHIEF: Mack G. Croft

OBJECTIVES.--The purpose of the investigation is to determine and evaluate the effects upon the hydrologic system created by the expansion of the Gascoyne lignite mine. Specifically, the objectives are (1) to measure and predict the changes in the runoff characteristics, sediment load, and water quality of streams draining the mine area; and (2) to determine the location and extent of the major aquifers and predict the changes in chemical quality of water within them.

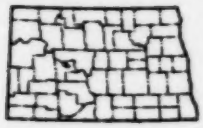
APPROACH.--The existing hydrologic system will be simulated with a digital conceptual model involving finite element and difference approximations of the ground-water and surface-water flow equation. Data for the models will be obtained from new and existing test wells and gaging stations.

PROGRESS IN 1980.--The report was given extensive review inhouse, by Region staff, and by research project personnel in Reston. There appear to be significant data deficiencies to support the interpretations. These data are being collected under project ND80-089. The digital model will be published separately from the interpretive report.

PLANS FOR 1981.--Plans are to complete the revisions based on the newly organized data and process the interpretive report for publication. The digital model will be revised on the basis of the new data and interpretation.

REPORT PRODUCTS.--Croft, M. G., and others, Hydrologic effects of strip mining in the Gascoyne area, Bowman County, North Dakota (in progress).

PROJECT TITLE: Hydrologic Evaluation of Mining and Reclamation, Beulah Trench Area, Mercer County, West-Central North Dakota



LOCATION: Central Mercer County, North Dakota

PERIOD OF PROJECT: April 1976 to September 1979

PROJECT CHIEF: Orlo A. Crosby

OBJECTIVES.--(1) To define premining hydrologic and geochemical conditions in a 28-square-mile area to provide historical data for the measurement of the magnitude of change during and after mining. (2) To provide, on basis of observations from this study site, guidelines for mining and reclamation that will minimize adverse effects of these operations on the hydrologic system. (3) To determine the hydrologic and chemical effects of mining operations on the Antelope Creek aquifer.

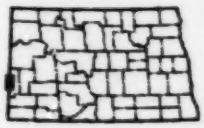
APPROACH.--Initially there will be a collation and evaluation of all existing hydrologic and geochemical data from prior studies in the area. Conceptual models of the hydrologic and geochemical systems will be developed and sites selected for the collection of needed geologic, hydrologic, and chemical data. As data are collected and analyzed, the model of the system will be refined. If feasible, the system will be represented by a digital model to be used in evaluating development in the future.

PROGRESS IN 1980.--The draft of the final report was completed and is ready for data and editorial check and technical review.

PLANS FOR 1981.--Plans for 1981 are to complete the review process and obtain Director's approval for publication.

REPORT PRODUCTS.--Hydrologic characteristics and possible effects related to surface mining in an Antelope Creek tributary basin, Mercer County, North Dakota (in progress).

PROJECT TITLE: Evaluation of Probable Hydrologic Effects of Future Lignite Mining and Reclamation Activities in the Wibaux-Beach Deposit Area, Wibaux County, Montana, and Golden Valley County, North Dakota



LOCATION: Montana-North Dakota Border, Central Latitude

PERIOD OF PROJECT: October 1977 to September 1980

PROJECT CHIEF: William F. Horak, Jr.

OBJECTIVES.--(1) To define the premining hydrologic and geochemical regime within the drainage basins containing the Wibaux-Beach lignite deposit. In so doing, a historical data base will be established with which to assess any modifications attendant on future coal mining. (2) To develop the capability of projecting the hydrologic ramifications of various land treatments imposed by the mining process.

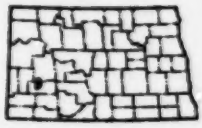
APPROACH.--Strip mining disrupts the zone of interaction between the atmospheric, terrestrial, and subterranean segments of the hydrologic cycle. Programs and instrumentation necessary to determine the flow and quality characteristics and the various modes of exchange of water between the respective segments will be initiated early in the project. The data collected will be used in conjunction with digital models to gain a thorough knowledge of the hydrologic regime. Quantitative hydrologic parameters will be refined and data deficiencies will be identified with the aid of the models. When the models are calibrated and verified against the present hydrologic system, they will be available for estimating the hydrologic ramifications of various land treatments within the study area.

PROGRESS IN 1980.--All data-collection efforts have been completed. Three years of discharge records are available for the major streams of the area. One to 2 years of hydrographs are available for all observation wells, and chemical analyses are available for 90 percent of the wells. Three aquifers have been identified. The Harmon lignite aquifer, the shallowest of the three, persists over a vast area and will produce modest yields to wells in most locations. The other two aquifers consist of sand beds that underlie the lignite at variable depth intervals but occur much less consistently than the lignite aquifer. Permeability data derived from about 30 single-well aquifer tests are being incorporated into a flow model of the ground-water system.

PLANS FOR 1981.--The flow model will be calibrated and used to project potential impacts of strip mining on the ground-water system. A final report will be written and submitted for review.

REPORT PRODUCTS.--Evaluation of probable hydrologic effects of future lignite mining and reclamation activities in the Wibaux-Beach deposit area, Wibaux County, Montana, and Golden Valley County, North Dakota (in progress).

PROJECT TITLE: Evaluation of Probable Hydrologic Effects of Future Lignite Mining and Reclamation Activities in the Rattlesnake Butte Area, North Dakota



LOCATION: Western North Dakota

PERIOD OF PROJECT: October 1978 to September 1981

PROJECT CHIEF: William F. Horak, Jr.

OBJECTIVES.--The primary objective is to define the hydrologic regime in the greatest possible detail consistent with the project duration and funding. This will include assessment of the ground-water and surface-water systems and chemical characteristics in the systems. By defining the hydrologic regime of the study area, a second objective will be satisfied--the establishment of a historical data base with which to monitor changes in the system as mining proceeds. The ultimate objective is to develop the capability of making reasonably accurate projections of the hydrologic effects resulting from surface mining.

APPROACH.--There will be a collation and evaluation of all existing hydrologic and geochemical data in the area. From these data, conceptual models of the hydrologic and geochemical systems will be developed. Data will be collected at locations necessary to further define the systems. The hydrologic system will be represented through digital models to evaluate probable stress due to development.

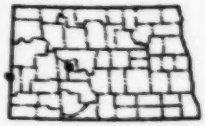
PROGRESS IN 1980.--The second phase of test drilling and observation-well construction was completed in FY80. Preliminary interpretation of the data indicate a system of fluvial channel sands of the basal Sentinel Butte Member (Fort Union Formation) transecting the central part of the study area from west to east. These sand beds, up to 80 feet thick in places, constitute an aquifer system. The commercial lignite bed underlies the eastern third of the study area and is the only other consistently occurring aquifer within 400 feet of the land surface. In areas underlain by neither of these aquifers, water suplies are generally obtained from the basal Tongue River sands, at some 600 to 800 feet in depth.

PLANS FOR 1981.--Data compilation will be completed and the interpretive products will be prepared. These will include potentiometric, structure, and isopach maps of the aquifers. The final report will be prepared and submitted for review.

REPORT PRODUCTS.--Hydrologic evaluation, Rattlesnake Butte area, North Dakota (planned).

PROJECT TITLE: Evaluation Through Modeling of Probable Surface-Water Hydrologic Effects of Future Lignite Mining and Reclamation Activities in the Antelope Creek Area, Mercer County, North Dakota, and the Wibaux-Beach Deposit Area, Wibaux County, Montana, and Golden Valley County, North Dakota

LOCATION: Mercer County, North Dakota, and Wibaux County, Montana



PERIOD OF PROJECT: October 1979 to September 1983

PROJECT CHIEF: Douglas G. Emerson

OBJECTIVES.--The objectives of this investigation are (1) to determine premining hydrologic conditions in a small representative drainage basin, (2) to provide historical data with which to compare the magnitude of change with mining, and (3) to develop the capability of making reasonably accurate projections of hydrologic effects resulting from the various land treatments imposed by surface mining.

APPROACH.--This will be a very comprehensive study of two small representative watersheds. A surface-water model will be developed through coupling of snowmelt-rainfall-runoff models. A modular-design program will be used with each element of the hydrologic system being defined by a subroutine. This program has the capability of combining subroutines to best fit a particular problem. A distribution-parameter approach is being used by having the basin partitioned into subunits based on slope, aspect, vegetation type, soil type, and snow distribution. Each subunit will be considered homogeneous with respect to these parameters. Partitioning into subunits will help define the temporal and spatial variations of the hydrologic characteristics, climatic variables, and overall system response.

PROGRESS IN 1980.--Hydrological, meteorological, and chemical quality data have been collected. The data are being reviewed and stored in the WATSTORE computer system. Simplistic preliminary digital model runs have been made on the Antelope Creek basin for the 1977 water year. An updated version of the model along with a draft copy of the documentation was made available in August.

PLANS FOR 1981.--Data collection, storage, and analysis will continue. More elaborate model runs will be made on the Antelope Creek basin using the revised model, and preliminary model runs will be made on Hay Creek basin.

REPORT PRODUCTS.--Surface-water modeling of the Fort Union coal region (planned).

PROJECT TITLE: Geochemistry of the Upper Fort Union Group as Related to Impacts of Strip Mining of Lignite in the Gascoyne Area, North Dakota

LOCATION: North Dakota

PERIOD OF PROJECT: October 1979 to September 1982

PROJECT CHIEF: Robert L. Houghton

OBJECTIVES.--The purpose of this investigation is to quantitatively describe major controls on the movement of critical solutes in local and regional ground-water systems within the Fort Union Group affected by surface mining of lignite in western North Dakota. Specific objectives at the Gascoyne site will be to define the hydrogeologic and hydrogeochemical character of the shallow ground-water system in the area and to ascertain the source of observed anomalous sulfate concentrations.

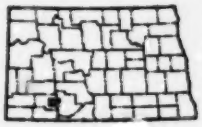
APPROACH.--The first phase will be to establish a clear and complete understanding of the hydrologic regime. Next the mineralogy and mineral chemistry of the Fort Union Group will be determined. Thirdly, an accurate determination must be made of the cation-exchange reaction rates and constants. Fourth, oxidation-reduction reactions must be determined for important species pairs and, finally, the solute flux from mine to locations of water use will be determined.

PROGRESS IN 1980.--A literature search of geochemical effects of lignite strip mining was initiated and established on a self-continuing basis. Existing surface- and ground-water quality data for the Gascoyne area was compiled and analyzed. The current water-quality collection network was evaluated and sampled twice (on quarter), and eight new observation wells were installed and sampled. Preliminary isopach and lithofacies maps were developed for the Gascoyne area. Reevaluation of the hydrologic regime was initiated in eight of the reinterpreted geologic structure and new well observations. Spoils and core samples were collected and initial cation-exchange and leaching experiments undertaken.

PLANS FOR 1981.--Completion of geologic evaluation of the area including development of fence diagrams and paleo-environmental surfaces. Complete preliminary evaluation of hydrologic regime. Obtain new core material and undertake additional (1) quantitative determination of mineralogy and mineral chemistry, (2) cation-exchange experiments, and (3) soluble-salt experiments. Sample existing network and new cored wells quarterly and begin initial evaluation of water-quality data. Complete a preliminary equilibrium model of water-quality data and utilize this model to evaluate new data needs and to develop an outline for programming solute transport at the site.

REPORT PRODUCTS.--Geochemical effects of strip mining in the Fort Union coal region (planned).

PROJECT TITLE: Evaluation of the Hydrologic System in the New Leipzig Coal Area, Grant and Hettinger Counties, North Dakota



LOCATION: Southwestern North Dakota

PERIOD OF PROJECT: October 1980 to September 1981

PROJECT CHIEF: Clarence A. Armstrong

OBJECTIVES.--The primary objective will be to define the hydrologic regime in the greatest possible detail consistent with the project duration and funding. This will include assessment of the ground-water flow system and chemical characteristics and determination of surface-water flow magnitudes, chemical quality, sediment concentration, and sediment load. By defining the hydrologic regime of the study area, a second objective will be satisfied--the establishment of a historical data base with which to monitor changes in the system as mining proceeds.

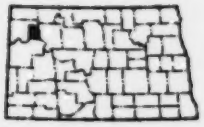
APPROACH.--Existing geologic and hydrologic data will be assembled and used to establish an information framework of the study area. Limited surface-runoff, water-level, and quality-of-water information will be collected in the field. Where possible, regionalized information will be used to define the hydrology. The final report will assess the available information and make recommendations as to whether further study is needed for leasing purposes.

PROGRESS IN 1980.--None. New project.

PLANS FOR 1981.--Assemble existing data, collect necessary field data, compile and analyze data, and complete final report.

REPORT PRODUCTS.--Hydrology of New Leipzig, North Dakota, coal area (planned).

PROJECT TITLE: Evaluation of Probable Hydrologic Effects of Future Lignite Mining and Subsequent Reclamation Activities in the M & M Deposit, Williams County, North Dakota



LOCATION: Northwestern North Dakota

PERIOD OF PROJECT: October 1980 to September 1983

PROJECT CHIEF: Robert L. Klausing

OBJECTIVES.--Define the hydrologic regime in the greatest possible detail consistent with the duration of the study and funding. This will include assessment of the ground-water flow system and its chemical characteristics, determination of flow frequencies and magnitude, chemical quality, and sediment concentration and load of the larger streams. Establish a historical data base. Develop the capability for projecting the hydrologic effect of physical treatments imposed by surface mining.

APPROACH.--Data will be assembled and collected for use in conjunction with digital models to define the ground-water flow system. The surface-water system will be defined through available records, data collection, and regionalized equations. Quality of water will be defined through an intensive sampling program. Methods for estimating the hydrologic effects of various land treatments imposed by mining will be developed.

PROGRESS IN 1980.--None. New project.

PLANS FOR 1981.--Review all pertinent literature. Assemble and compile all relevant ground-water, surface-water, and chemical-quality data. Update existing water records. Prepare preliminary geologic maps. Obtain property easements. Plan test drilling. Complete initial test drilling. Collect water samples from observation wells. Measure spring runoff in major streams. Make low-flow measurements in fall. Compile and analyze data collected.

REPORT PRODUCTS.--Lithologic and geophysical logs of lignite drilling (planned).

Hydrologic effects of lignite mining (planned).

BOARDS AND COMMISSIONS

PROJECT TITLE: Boards and Commissions

LOCATION: Bismarck, North Dakota

PERIOD OF PROJECT: Continuous

PROJECT CHIEF: L. Grady Moore

OBJECTIVES.--Assure impartial Federal representation on the Yellowstone River Compact Commission and the Souris River Board of Control and supply accurate unbiased information to the Pembina River Engineering Board.

APPROACH.--Chair the meetings and provide administrative support to the Yellowstone River Compact Commission. Act as United States member and furnish secretarial services to the Souris River Board of Control. Furnish information requested by members of the Pembina River Engineering Board.

PROGRESS IN 1980.--The 1979 Annual Report of the Souris River Board of Control was printed and distributed. Meetings of the Board were held January 24, 1980, and May 22, 1980. Information was routinely furnished to parties concerned with Souris River streamflow. The 1979 Annual Report of the Yellowstone River Compact Commission was printed and distributed. Meetings of the Commission were held November 14, 1979, in Casper, Wyo., and April 9, 1980, in Cody, Wyo.

PLANS FOR 1981.--All meetings of the Souris River Board of Control will be attended. The Annual Report for 1980 will be prepared and distributed. All meetings of the Yellowstone River Compact Commission and the Administration Committee will be attended. The Annual Report for 1980 will be prepared and distributed.